Appendix B Worksheets

The following worksheets are designed to assist quality assurance (QA) inspectors in performing inspections of construction of NRCS projects. Blank worksheets are provided along with instructions on completing the worksheets and a sample of completed worksheets,

Maintain completed worksheets at the jobsite with the inspector's records, and submit them to the contracting officer's representative (COR)/government representative (GR) along with the job diary when the work is completed. Document in the job diary when each worksheet is completed.

Each worksheet is designated NEH 645 WS #.#. The first number corresponds to the NEH 645 chapter to which the worksheet is directly associated. Some worksheets will apply to work that is described in more than one chapter, but are designated with the number of the chapter being the most relevant to the worksheet.

Electronic spreadsheets and programs corresponding to some of the worksheets are available to NRCS personnel at: https://nrcs.sc.egov.usda.gov/st/ndcsmc/construction/default.aspx. This can only be accessed from an agency computer.

Appendix B Worksheets

Contents

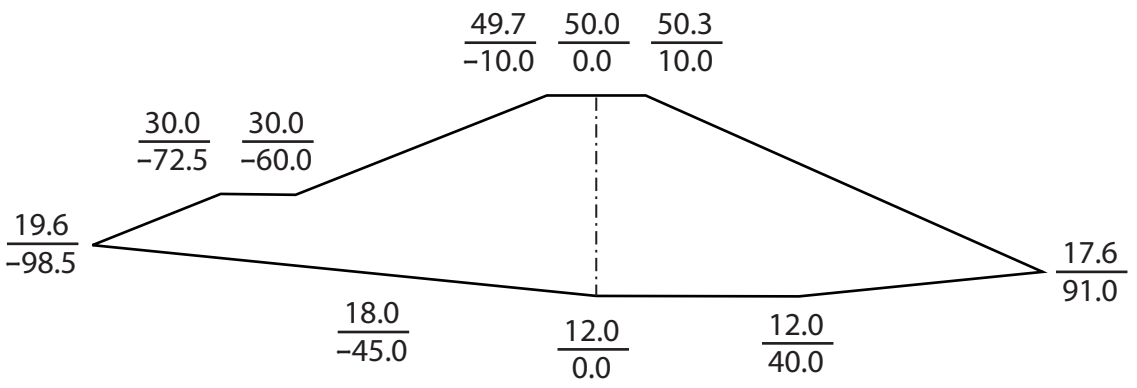
NEH 645 WS 5.1	Earthwork Survey Data and Computation Sheet	B–5.1–1
NEH 645 WS 5.2	Earthwork Volume Computation Sheet	B–5.2–1
NEH 645 WS 5.3	Payment Quantity Computations Summary	B–5.3–1
NEH 645 WS 7.1	Materials Testing Report	B–7.1–1
NEH 645 WS 7.2	Field Density and Water Content by the Clod Method	B–7.2–1
NEH 645 WS 7.3	Report of Blasting Operation	B–7.3–1
NRCS–ENG–005	(Postcard)	B–7.005–1
NRCS–ENG–006	Utility Check Sheet	B–7.006–1
NEH 645 WS 13.1	Record of Aggregate Moisture	B–13.1–1
NEH 645 WS 13.2	Field Mix Evaluation	B–13.2–1
NEH 645 WS 13.3	Apparent Maximum Density (AMD) Determination	B–13.3–1
NEH 645 WS 13.4	RCC Lift Summary	B–13.4–1
NEH 645 WS 13.5	In-Place RCC Density and Moisture Test Results	B–13.5–1
NEH 645 WS 13.6	RCC Compressive Strength Test Results	B–13.6–1

NEH 645 WS 5.1 Earthwork Survey Data and Computation Sheet

WS 5.1, Earthwork Survey Data and Computation Sheet, is used to compute the volume of earthfill or excavation using the double end area method. The double end area method is similar to the average end area method described in chapter 5. In the sample WS 5.1, the double end area method, a value equal to twice (double) the cross-sectional area is computed by the rectangular coordinate method. The value is then added to the same value attained for the next cross section. The result is a value that is four times the average of the cross-sectional areas of the two sections. This value is divided by 4 and multiplied by the distance between the stations to arrive at the volume between the two stations. The steps are explained below.

Step 1 Using WS 5.1, record the rectangular coordinates that define each section in feet to the nearest tenth of a foot. These coordinates are determined by the limits of excavation or earthfill, which are generally stated in the construction specifications for excavation and earthfill. For example, the limits for stations shown on sample WS 5.1 were specified to be "the measured surface of the foundation when approved for placement of the earthfill and the specified neat lines of the earthfill surface." Thus, the foundation limits are obtained from a field survey of the ground after the foundation excavation is completed and prior to beginning earthfill placement. The upper limits of the sections are obtained from the drawings. This is illustrated in figure B5–1. In figure B5–1, the foundation limits are defined by the lines connecting the points $\frac{19.6}{-98.5}$, $\frac{18.0}{-45.0}$, $\frac{12.0}{0.0}$, $\frac{12.0}{40.0}$, and $\frac{17.6}{91.0}$; the upper limits are defined by the lines connecting the points $\frac{19.6}{-98.5}$, $\frac{30.0}{-72.5}$, $\frac{30.0}{-60.0}$, $\frac{49.7}{-10.0}$, $\frac{50.0}{-0.0}$, $\frac{50.3}{-10.0}$, and $\frac{17.6}{-91.0}$.

Figure B5–1 Cross section at Station 5+00



Step 2 Compute the double end areas of each section by the rectangular coordinate method.

Step 3 Add the double end areas of consecutive sections.

Step 4 Multiply the value obtained in step 3 by the distance between the two sections and divide by 4 to determine the cross-sectional area in square feet.

Step 5 Divide the value obtained in step four by 27 to convert to cubic yards.

Step 6 Add the volumes computed between each station to determine the total volume of the earthfill or excavation.

Sample NEH 645 WS 5.1

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 5.1 Earthwork Survey Data and Computation Sheet

Location Hardin, Montana Owner John Doe Contractor Crow Construction Contract No. WC-82-12
Watershed Big Horn Item 7 Computed by J. Gray Date 11-30-2011
Subwatershed Winona Creek Site No. 4 Final quantity (yd^3) 15,887 Checked by N. Ricks Date 12-01-2011

Station	Lt *				℄ *				Rt *				Double end areas	∑	Distance	Product ÷ 4	÷27
5+00	50.0	50.3	17.6	12.0	12.0	18.0	19.6	30.0	30.0	49.7	50.0						
	0.0	10.0	91.0	40.0	0.0	-45.0	-98.5	-72.5	-60.0	-10.0	0.0		7,693.3				
5+50	50.0	50.3	15.4	14.3	12.5	13.9	14.0	30.0	30.0	49.7	50.0			16,081.4	50.0	201,018	7,445.1
	0.0	10.0	96.5	51.0	0.0	-50.0	-112.0	-72.5	-60.0	-10.0	0.0		8,388.1				
6+00	50.0	50.3	11.4	8.6	12.8	30.0	30.0	49.7	50.0					18,234.5	50.0	227,931	8,441.9
	0.0	10.0	107.3	0.0	-115.5	-72.5	-60.0	-10.0	0.0				9,846.4				
														Total			15,887.0

* Provide appropriate headings for use of offset, centerline, or baseline.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 5.1

Earthwork Survey Data and Computation Sheet

Location ______________________________ Owner ______________________________ Contractor __________________________________ Contract No. _________

Watershed ____________________________ Item ____ Computed by ________________________ Date ________________

Subwatershed __________________________ Site No. _____ Final quantity (yd^3) __________ Checked by __________________________ Date ________________

Station	_______*				_______*				_______*				Double end areas				

* Provide appropriate headings for use of offset, centerline, or baseline.

This page intentionally left blank.

NEH 645 WS 5.2 Earthwork Volume Computation Sheet

WS 5.2, Earthwork Volume Computation Sheet, is used to compute the volume of earthfill or excavation when the cross-sectional area at each station is predetermined. Methods for computing cross-sectional area are described in chapter 5.

When the cross-sectional area at each station is determined by the planimeter method, it will be given in square inches. The conversion to square feet will require multiplying the area in square inches by a conversion factor. This factor is contingent on the scale of the map or plotted cross section that was traced by the planimeter to determine the area in square inches.

If the cross-sectional area at each station was determined by a method that yields values in square feet, the second column in WS 5.2 is not needed. The following steps describe the process of computing volumes using WS 5.2.

Step 1 Record the station numbers in the first column and the distance between cross sections in the fifth column. Record these numbers in feet to the nearest tenth of a foot.

Step 2 If the cross-sectional areas are given in square inches, record the values in the second column, multiply the value by the conversion factor mentioned above, and record the converted square foot value in the third column. If the cross-sectional areas are given in square feet, leave the second column blank and record the square foot values in the third column.

Step 3 Add the square foot cross-sectional areas of consecutive stations and record the sum in the fourth column.

Step 5 Multiply the values in columns 4 and 5; record this value in the sixth column. This value represents the section product which is double the volume in square feet. Complete this computation for all consecutive pairs of stations.

Step 6 Add all section products in column 6, and divide the total by 54 to convert to volume in cubic yards. Record this number in the seventh column. If desired, the sum of all the values recorded in the sixth column divided by two gives the volume of the earthwork in cubic feet.

Sample NEH 645 WS 5.2

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 5.2 **Earthwork Volume Computation Sheet**

Project Town Creek Watershed, Site 5 Job No. 12-10-330-43
Location Benton, Indiana Contractor Elkhart Construction
Item Excavation Sheet 1 of 1
By D. Shanklin Date 11-30-11 Checked by D. McCook Date 12-01-11

Station	End area (in^2)	End area (ft^2)	Sum of end areas (ft^2)	Distance (ft)	Section product (ft^3)	Volume (yd^3)	Remarks
12+40	0.00	0					
			245	60	14,700		
13+00	2.45	245					
			495	50	24,750		
13+50	2.50	250					
			507	50	25,350		
14+00	2.57	257					
			497	50	24,850		
14+50	2.40	240					
			316	100	31,600		
15+50	0.76	76					
			186	50	9,300		
16+00	1.10	110					
			164	100	16,400		
17+00	0.54	54					
			139	50	6,950		
17+50	0.85	85					
			187	50	9,350		
18+00	1.02	102					
			102	40	4,080		
18+40	0.00	0					
					167,330		
			Total	167,330	=3,099 yd^3		
				(2)(27)			
Cross section scale		1 inch =	10 ft vertical				
		1 inch =	10 ft horizontal				
		(1 in^2 =	100 ft^2)				

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 5.2 Earthwork Volume Computation Sheet

Project ______________________________ Job No. __________

Location ____________________ Contractor ____________________

Item ______________________________ Sheet ____ of ____

By ____________ Date ________ Checked by ____________ Date ________

Station	End area (in^2)	End area (ft^2)	Sum of end areas (ft^2)	Distance (ft)	Section product (ft^3)	Volume (yd^3)	Remarks

This page intentionally left blank.

NEH 645 WS 5.3 Payment Quantity Computations Summary

WS 5.3, Payment Quantity Computations Summary, is used to record computed quantities for payment. It is generally filed with the payment quantity computations that are with for contract records. The worksheet is typically used for jobs where there are several variable quantity contract items that require final quantity computations. It is simply a tool for organizing and keeping up with quantity computation progress.

Sample NEH 645 WS 5.3

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 5.3 Payment Quantity Computations Summary

Location Putnam County, Georgia Owner Luke Dunn

Watershed Rooty Creek Subwatershed —

Site No. 25 Contract No. 6-GA-SCO-5

Item No.	Work or material	Computed			Checked		
		Date	Name	Quantity	Date	Name	Quantity
1	Clearing	5-1-63	L.A.H.	11.2 acres	5-4-63	W.J.P.	11.2 acres
2	Clearing and grubbing						
	Embankment area	5-1-63	L.A.H.	1.6 acres	5-4-63	W.J.P.	1.6 acres
	Emergency spillway	5-1-63	L.A.H.	2.5	5-4-63	W.J.P.	2.5
	Total	5-1-63	L.A.H.	4.1 acres	5-4-63	W.J.P.	4.1 acres
3	Evacation						
	Conduit strip out	5-1-63	L.A.H.	19.9 yd^3	5-4-63	W.J.P.	19.9 yd^3
	Key way	5-1-63	L.A.H.	2,533	5-4-63	W.J.P.	2,533
	Old channel	5-1-63	L.A.H.	1,172	5-4-63	W.J.P.	1172
	Tail ditch	5-1-63	L.A.H.	196	5-4-63	W.J.P.	196
	Total	5-1-63	L.A.H.	5,620 yd^3	5-4-63	W.J.P.	5,620 yd^3
4	Earthfill						
	Embankment	5-11-63	L.A.H.	15,267 yd^3	5-11-63	W.J.P.	15,267 yd^3
	Condiut strip out	5-11-63	L.A.H.	1,919	5-11-63	W.J.P.	1,919
	Key way	5-11-63	L.A.H.	2,335	5-11-63	W.J.P.	2,335
	Old channel	5-11-63	L.A.H.	1,172	5-11-63	W.J.P.	1,172
	Total	5-11-63	L.A.H.	20,691 yd^3	5-11-63	W.J.P.	20,691 yd^3
5	Concrete-Class B						
	Riser	5-11-63	L.A.H.	5.47 yd^3	5-11-63	W.J.P.	5.47 yd^3
	Anti-seep collars	5-11-63	L.A.H.	3.15	5-11-63	W.J.P.	3.15
	Anti-kortex baffle	5-11-63	L.A.H.	2.54	5-11-63	W.J.P.	2.54
	Sill	5-11-63	L.A.H.	2.96	5-11-63	W.J.P.	2.96
	Total	5-11-63	L.A.H.	14.12 yd^3	5-11-63	W.J.P.	14.12 yd^3
	Drainage filter						
	Material	5-5-63	L.A.H.	178 yd^3	5-5-63	W.J.P.	178 yd^3

Sheet: 1 of 1 sheets

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 5.3 Payment Quantity Computations Summary

Location _____ Owner _____

Watershed _____ Subwatershed _____

Site No. _____ Contract No. _____

Item No.	Work or material	Computed			Checked		
		Date	Name	Quantity	Date	Name	Quantity

Sheet: _____ of _____ sheets

This page intentionally left blank.

NEH 645 WS 7.1 Materials Testing Report—Visual Soil Classification

WS 7.1 is used for field classifying soils according to the procedure detailed in ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The worksheet is divided into five major columns, each divided by a double vertical line. The major columns are entitled: Identification, Coarse Fraction, Fine Fraction, Total Soil, and Classification.

Identification—The first major column is labeled "Identification." Under the Identification heading, there are two columns with blank headings that must be filled in. In the example, the first heading is recorded as "Dam Centerline Station," and the second heading is recorded as "Distance Upstream (ft)." The distance upstream is the distance to the sample location from the centerline in the upstream direction. Any reference line and offset distance could be used. Northing and easting coordinates are commonly used for establishing horizontal control and could be used instead of a reference line and offset distance. The objective is to provide a reference that can easily be documented and reestablished if necessary. Fill in the headings of these two columns with a clear description such as "Northing" and "Easting," "Baseline" and "Distance L or R from Baseline," "X" and "Y," etc.

The third column under the Identification heading is for recording a sample number, and the fourth column is for recording the depth below the surface at which the soil is sampled.

Coarse Fraction—For soils containing sands and gravels, there are five columns under this major heading. The first is the maximum particle size, which can be determined by sieves or estimated with a pocket millimeter scale or ruler. The other columns are particle shape, particle condition, % gravel, and % sand. Particle shape and condition are recorded by symbols listed on the second page of WS 7.1. These are described in more detail in ASTM D2488. The % gravel and % sand are recorded as a percentage of the total soil sample. So, the percentage of gravel and sand would be subtracted by 100 to determine the % fines to be recorded for the fine fraction. Sieving the soils to determine these percentages will only require having two sieve sizes: #4 and #200. Particles retained on the #4 sieve are gravel, particles retained on the #200 are sand, and particles passing the #200 sieve are fines. If it is apparent there are no sand and gravel particles, record N.A. (not applicable) in the first coarse fraction column, and draw a line through the remaining four columns under the coarse fraction heading.

Fine Fraction—Record the % fines in the first column under this major heading. Record the symbol for plasticity, dry strength, and dilatence, which are found on the second page of WS 7.1. A short description of each of these is also given on the second page of WS 7.1. These are described in detail in ASTM D2488.

Total Soil—The three columns under this major heading are organic odor, reaction to HCL, and color (wet). Organic odor symbols are listed on the second page of WS 7.1 as "S, W, or N" for strong, weak, or none respectively. Record the reaction with HCL as "+" if there is an effervescence or "-" if no apparent reaction occurs from a few drops of HCL dropped onto the soil. (Note that the reaction with HCL is an option in ASTM D2488; testing and recording the reaction to HCL is not required. A reaction with HCL infers the potential for soil cementation, which may be useful to know in some instances.) A dark brown to black color indicates the potential for organic materials in the soil.

Classification—This final major heading contains two columns. The first is a description to include such items as classification, grading, structure, consistency, moisture condition, inclusions, etc. The first sample entry on the example worksheet describes the soil as "fine grained, grading N.A., soft, wet, no inclusions." Only receord the items needed to determine the classification. Since the sample contained 100 percent fines, it is classified as a fine-grained soil. Grading only applies to sands and gravels that are either poorly graded or well graded; thus,

NEH 645 WS 7.1 Materials Testing Report—Visual Soil Classification—continued

grading does not apply for this soil. On the second sheet of WS 7.1 in the lower third of the sheet is a table that summarizes the field classification. All soils with over 50 percent fines fall in one of five groups: ML; CL; CH; MH; or OL, OH. The table shows that the soil would need to have a strong odor to be considered OL, OH. Since this soil has a weak odor, the potential group symbols for this soil are reduced to four groups: ML, CL, CH, or MH. The table shows that "None – Slow" dilatence is characteristic of a CL or MH. Since this soil has an "S" or slow dilatence, it is either a CL or MH. Only a CL can have a high dry strength, and the dry strength of this soil was recorded as high; thus, the soil is classified as a CL.

Sample NEH 645 WS 7.1

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.1

Materials Testing Report
Visual Soil Classification

Project *Cow Bayou Site 4* Tested by *Earl Grey* Date *January 4, 2012* Sheet *3* of *7*

Identification				Coarse Fraction					Fine Fraction				Total Soil			Classification	
Dam CL Sta.	Dist. Upstream (ft)	Field sample No.	Depth (ft)	Maximum size (mm)	Particle shape	Particle condition	% Gravel (3-inch to #4)	% Sand (#4 to #200)	% Fines (minus #200)	Plasticity	Dry Strength	Dilatence	Organic odor (wet)	Reaction to HCl	Color (wet)	Description (classification, grading, structure, consistency, moisture condition, inclusions, etc.)	Group symbol
4+80	200	5	10	N.A. →					100	M	H	S	Weak	No	Black	Fine grained, grading N.A., very soft, wet, no inclusions	CL
6+50	250	10		8	R	D	5	75	20	L	L	N	Weak	No	Light Brown	Coarse grained, grading N.A., soft, moist, no inclusions	SM
8+90	425	12	15	60	1/3 flat and long	D	90	10	0	N.A.	N.A.	N.A.	None	N.A.	Grey	Clean gravel, all about 1" in size	GP

Remarks

Sample NEH 645 WS 7.1—continued

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.1 Soil Description

Page 2 of 2

	Test	Description	Symbol	Identification or test reaction
Coarse Fraction	Particle Shape	Angular	A	Irregular shape: sharp edges
		Subangular	SA	Irregular shape: fairly sharp edges
		Subrounded	SR	Irregular shape: rounded edges
		Rounded	R	Fairly regular shape: rounded edges
	Particle Condition	Soft	S	Rubber pestle will break particles
		Vesicular	V	Individual grains contain air voids
		Dense	D	Massive: grains contain no air voids
Fine Fraction	Plasticity	High	H	Tough thread, will remold below plastic limit
		Medium	M	Medium tough thread, crumbles below plastic limit
		Low	L	Weak thread, will not remold at plastic limit
		None	N	Will not form thread
	Dry Strength	High	H	Difficult to break by finger pressure
		Medium	M	Considerable finger pressure to crumble
		Low	L	Will crumble at light finger pressure
		None	N	Will not form soil pat
	Dilatence	Rapid	R	Water surfaces immediately
		Slow	S	Water surfaces slowly
		None	N	Water will not surface
Total Soil	HCl	Positive	+	Effervescence
		Negative	-	No reaction
	Organic Odor	Strong	S	Strong odor when moist and hot
		Weak	W	Weak odor when moist and hot
		None	N	No organic odor

Classification

Group	Organic odor	Visual examination			Character of fines (< No. 40)		
		Grading	Percent fines	Dominant fraction	Dilatence	Dry strength	Plasticity
ML	Weak	Not a criterion for classification	Over 50	Fines	Rapid	None-Low	None-Low
CL	"		"	"	None-Slow	Med.-High	Medium
CH	"		"	"	None	High	High
MH	"		"	"	None-Slow	Low-Med	Low-Med.
OL,OH	Strong		"	"	None	Low-Med	Med.
SM	Weak		12-50	Sand	Fines classify as ML or MH		
GM	"		"	Gravel			
SC	"		"	Sand	Fines classify as CL or CH		
GC	"		"	Gravel			
SP	"	Poor	Under 5	Sand	Not a criterion for classification		
GP	"	"	"	Gravel			
SW	"	Well	"	Sand			
GW				Gravel			
Pt	Strong	Identify by high fibrous organic content					

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.1

Materials Testing Report
Visual Soil Classification

Project_____ Tested by_____ Date_____ Sheet_____ of_____

Identification				Coarse Fraction					Fine Fraction				Total Soil			Classification	
		Field sample No.	Depth (ft)	Maximum size (mm)	Particle shape	Particle condition	% Gravel (3-inch to #4)	% Sand (#4 to #200)	% Fines (minus #200)	Plasticity	Dry Strength	Dilatence	Organic odor (wet)	Reaction to HCl	Color (wet)	Description (classification, grading, structure, consistency, moisture condition, inclusions, etc.)	Group symbol

Remarks_____

	Test	Description	Symbol	Identification or test reaction
Coarse Fraction	Particle Shape	Angular	A	Irregular shape: sharp edges
		Subangular	SA	Irregular shape: fairly sharp edges
		Subrounded	SR	Irregular shape: rounded edges
		Rounded	R	Fairly regular shape: rounded edges
	Particle Condition	Soft	S	Rubber pestle will break particles
		Vesicular	V	Individual grains contain air voids
		Dense	D	Massive: grains contain no air voids
Fine Fraction	Plasticity	High	H	Tough thread, will remold below plastic limit
		Medium	M	Medium tough thread, crumbles below plastic limit
		Low	L	Weak thread, will not remold at plastic limit
		None	N	Will not form thread
	Dry Strength	High	H	Difficult to break by finger pressure
		Medium	M	Considerable finger pressure to crumble
		Low	L	Will crumble at light finger pressure
		None	N	Will not form soil pat
	Dilatence	Rapid	R	Water surfaces immediately
		Slow	S	Water surfaces slowly
		None	N	Water will not surface
Total Soil	HCl	Positive	+	Effervescence
		Negative	-	No reaction
	Organic Odor	Strong	S	Strong odor when moist and hot
		Weak	W	Weak odor when moist and hot
		None	N	No organic odor

Classification

Group	Organic odor	Visual examination			Character of fines (< No. 40)		
		Grading	Percent fines	Dominant fraction	Dilatence	Dry strength	Plasticity
ML	Weak	Not a criterion for classification	Over 50	Fines	Rapid	None-Low	None-Low
CL	"		"	"	None-Slow	Med.-High	Medium
CH	"		"	"	None	High	High
MH	"		"	"	None-Slow	Low-Med	Low-Med.
OL,OH	Strong		"	"	None	Low-Med	Med.
SM	Weak		12-50	Sand	Fines classify as ML or MH		
GM	"		"	Gravel			
SC	"		"	Sand	Fines classify as CL or CH		
GC	"		"	Gravel			
SP	"	Poor	Under 5	Sand	Not a criterion for classification		
GP	"	"	"	Gravel			
SW	"	Well	"	Sand			
GW				Gravel			
Pt	Strong	Identify by high fibrous organic content					

NEH 645 WS 7.2 Field Density and Water Content by the Clod Method (ASTM D7263)

One of the better methods for determining the moisture and density of an undisturbed sample of soil is ASTM D7263, Laboratory Determination of Density (Unit Weight) of Soil Specimens (Method A—Water Displacement) commonly referred to as the "clod test." This method determines the density of an irregularly shaped clod. The general steps for the procedure are listed and illustrated in 645.0702. Refer to ASTM D7263 for standard test method details.

This test method is useful for obtaining the density of any soil or material. It is very useful when testing for collapsible soils. Collapsible soils are soils that, in their natural state, have a low density (dry density less than 90 lb/ft^3) and generally have low moisture content (less than 10%). Collapsible soils generally contain air holes that are visible to the naked eye. There are a couple of photos of collapsible soils in 645.0701 (see figs. 7–2 and 7–3).

A sample of soil that has minimum dimensions of approximately 4 inches in length, width, and depth is desired. It must be undisturbed and protected from moisture loss prior to obtaining a clod for the test. It must be transported in a manner that will protect it from impact or significant vibration or jarring to avoid collapse before the test is conducted. The clod used for the test is then obtained from this sample. At the time the clod is cut or broken out of the sample, a moisture sample is also obtained, placed in a container, and immediately weighed to determine the initial mass of moist soil + container. The clod should be weighed and the clod coated in wax before any moisture is lost.

Note in the sample calculations that the values are given to four significant digits. ASTM D7263 requires this level of accuracy which is needed because of the small clod size. Once the moist density is determined in grams per cubic centimeter, it is converted to pounds per cubic foot by multiplying by 62.4 and reported to the nearest 10th. In the sample calculations, the moisture content determined by ASTM D2216 (oven) was reported to the nearest 100th because the value is 14.65 percent. Anything from 14.6 to 14.64 can be rounded down to 14.6 and from 14.66 to 14.7 rounded up to 14.7.

Also note in the sample calculations, the technician obtained the moisture content by two methods. ASTM D2216 (the oven method) is considered the most accurate of all of the ASTM test methods for determining soil moisture. The oven method requires the soil to remain in the oven overnight. The other method used here was the microwave method (D4643); results can be obtained in a few minutes using a microwave oven. It resulted in slightly lower moisture content than that obtained using the oven. However, the difference in the values of dry density (85.1 lb/ft^3 verses 85.4 lb/ft^3) computed by using moisture values from the two methods is negligible for the purpose of confirming the low soil density.

Sample NEH 645 WS 7.2

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.2 Field Density and Water Content by the Clod Method (ASTM D7263)

Project Cow Bayou Site 4 Sheet 1 of 1

Computed by Earl Grey Date 1/4/2012

Checked by Floyd Jones Date

Density of the wax used for the test, (ρ_ρ) = 0.8812 g/cm^3

Density of the water used for the test, (ρ_w) = 0.9976 g/cm^3

In-place Density Measurement (nongravelly soils)

	Sample identification	3	
	Location sampled	CL 5+80 10 ft Left	
	USGS classification of sample	CL	
(1)	M_t = Mass of clod in air, grams	56.1013	
(2)	M_c = Mass of clod + wax in air, grams	61.0293	
(3)	M_{sub} = Mass of clod + wax submerged, grams	19.6683	
(4)	M_c – Mt = Mass of wax, grams (2) – (1)	4.9280	
(5)	$(M_c–M_t)/\rho_\rho$ = Volume of wax, cm^3 (4) / ρ_ρ	5.5924	
(6)	$(M_c–M_{sub})/\rho_w$ = Volume of clod, cm^3 [(2) – (3)] / ρ_w	41.4605	
(7)	ρ_m = Moist density, g/cm^3 (1) / [(6) – (5)]	1.5641	
(8)	ρ_m = Moist density, lb/ft^3 (7) x 62.4	97.6	97.6
(9)	ρ_d = Dry density, lb/ft^3 (8) / (1 + w%/100)	85.1	85.4

Water Content Measurement

	Method used	D2216	D4643
	Container or can no.	101	N.A.
(1)	Mass of container, grams	46.4322	20.2236
(2)	Mass of moist soil + container, grams	72.7102	41.5405
(3)	Mass of dry soil + container, grams	69.3522	38.8736
(4)	Water content, % [((2)–(3)) / ((3)–(1))] x 100	14.65	14.3

NEH 645 WS 7.2 Field Density and Water Content by the Clod Method (ASTM D7263)

Project_____ Sheet_____of_____

Computed by_____ Date_____

Checked by_____ Date_____

Density of the wax used for the test, (ρ_ρ) =_____ g/cm^3_____

Density of the water used for the test, (ρ_w) =_____ g/cm^3_____

In-place Density Measurement (nongravelly soils)

	Sample identification		
	Location sampled		
	USGS classification of sample		
(1)	M_t = Mass of clod in air, grams		
(2)	M_c = Mass of clod + wax in air, grams		
(3)	M_{sub} = Mass of clod + wax submerged, grams		
(4)	$M_c - Mt$ = Mass of wax, grams (2) – (1)		
(5)	$(M_c - M_t)/\rho_\rho$ = Volume of wax, cm^3 (4) / ρ_ρ		
(6)	$(M_c - M_{sub})/\rho_w$ = Volume of clod, cm^3 [(2) – (3)] / ρ_w		
(7)	ρ_m = Moist density, g/cm^3 (1) / [(6) – (5)]		
(8)	ρ_m = Moist density, lb/ft^3 (7) x 62.4		
(9)	ρ_d = Dry density, lb/ft^3 (8) / (1 + w%/100)		

Water Content Measurement

	Method used		
	Container or can no.		
(1)	Mass of container, grams		
(2)	Mass of moist soil + container, grams		
(3)	Mass of dry soil + container, grams		
(4)	Water content, % [((2) – (3)) / ((3) – (1))] x 100		

This page intentionally left blank.

NEH 645 WS 7.3 Report of Blasting Operation

A description of methods for developing a blasting plan is beyond the scope of this handbook; however, the inspector must have enough knowledge of blasting terminology to oversee the operation, understand how the plan may be revised to achieve more desirable results, and document the operation on WS 7.3 and in the diary. To that end, the inspector should study the information on blasting provided in chapter 7 and below, and consult with the responsible engineer.

The first three lines of the worksheet are self-explanatory. The fourth line is for describing the blast location. In the sample on page B–7.3–6, the location is clearly described as "50 to 66 feet left of auxiliary spillway CL Sta. 3+00 to 3+24." Attach and make reference to an additional sheet if more space or an illustration is needed to adequately describe the location.

Much of the remaining information can be obtained from the blasting plan. Keep in mind that the blasting plan is generally adjusted from one blast to the next as necessary to attain the desired results. Therefore, the data reported here will differ somewhat from that planned.

The reverse side of sample worksheet includes several sketches of general blasting patterns identified as Plans A through G. The sample information filled in on the front side of the worksheet refers to blasting pattern identified as Plan A.

Blasting agents—Black powder, dynamite, Ammonium Nitrate-Fuel Oil-Prill (ANFO), and water gels are common blasting agents. ANFO is a blasting agent most commonly used in excavation. It can only be used in dry conditions unless it is encapsulated in cartridge form to keep it dry. Water gels are, like ANFO, made from ammonium nitrate but, unlike ANFO, can be used in wet conditions without being encapsulated. Black powder and dynamite are no longer commonly used for mining or construction.

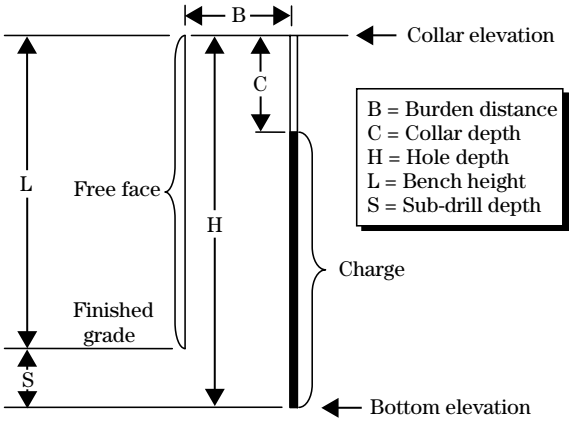
The amount of blasting agent used depends on several factors. One of these is the density of the blasting agent. Density is generally reported in grams per cubic centimeter (g/cm^3) and can be converted to pounds per cubic foot (lb/ft^3) by multiplying by 62.4. Blasting agent density ranges from 0.4 to 1.4 g/cm^3 (25 to 90 lb/ft^3) depending on the agent used. The blasting agent shown in the sample worksheet is ANFO–P (the P indicates poured or granular) with a density of 0.85 g/cm^3. It can be compacted to a density of 0.95 g/cm^3. There are other ANFO products, each having a different density.

Powder factor—The powder factor is the ratio of the amount of blasting agent to the amount of rock to be broken. The term "powder" originated from the use of black powder and refers to any solid blasting agent such as ANFO or water gel. The powder factor in the sample worksheet is 1 lb/yd^3. Overblasting will occur if the powder factor is too high. If the powder factor is too low, the rock will not be broken up enough and will be difficult to remove. The powder factor may be adjusted from one blast to the next to achieve the desired results.

Burden/spacing—Burden is the distance measured perpendicular from the nearest free face to the blast hole as shown in figure 7B.1. The generalized blasting patterns shown on the back of the sample WS 7.3 illustrate the relationship between burden and spacing.

NEH 645 WS 7.3 Report of Blasting Operation—continued

Figure 7B–1 Bench cross section showing blast hole geometry



Stemming—Stemming is used to fill the collar. The collar is the portion of the blast hole that is not charged (i.e., filled with blasting agent). Crusher fines, sand, and other inert granular materials are used for stemming materials.

Method of initiation—Blasting agents are ignited by an electric or nonelectric initiation device. Electric blasting caps are initiated by an electric charge. Nonelectric devices are initiated by a detonating cord that is generally a small plastic tube containing a flammable material.

Delay types—Both electric and nonelectric initiation can be delayed. The delay may be placed "in-line" between caps or be built into a "delay cap." An illustration of how both in-line delays and delay caps are used is seen in chapter 7, figure 7–11. In this figure, the point of initiation is at hole number 47. A 25-ms cap is used in each of the blast holes. The line from hole number 46 to holes 37 and 57 contain a 17-ms in-line delay.

The sample worksheet entry shows 10-ms caps. Generally an 8-ms delay is considered the shortest acceptable delay period. If the charges are closer together, the delay will not be effective. Delays that are too long can result in poor rock breakage or otherwise less desirable results.

Type of circuit—For electric initiation, there are three types of circuits: series, parallel, and series-in-parallel. Figure 7B–2 illustrates the series-in-parallel circuit commonly used in blasting for excavation. Individually, each row is a series circuit where the electric current enters one end of the row and flows out the opposite end. Current is supplied to each row independent of the other rows. Figure 7B–3 illustrates a series circuit. Figure 7B–4 illustrates a parallel circuit.

NEH 645 WS 7.3 Report of Blasting Operation—continued

Figure 7B–2 Series-in-parallel circuit

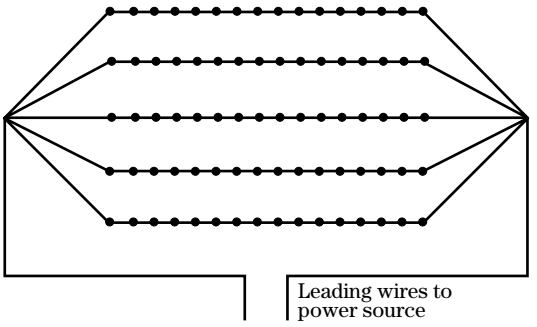


Figure 7B–3 Series circuit

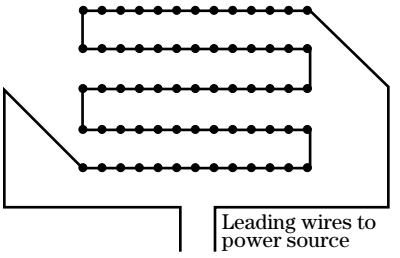


Figure 7B–4 Parallel circuit

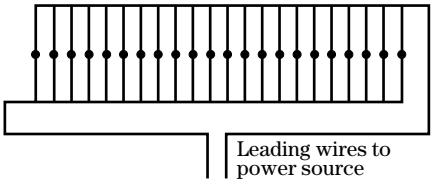


Table showing details of blast holes—The table is set up so that information can be input for up to four rows of 17 holes. There is a continuation sheet WS 7.3 (cont.) that can be attached if there are more rows or holes than space provided in the table.

The sample shows three rows and the holes are identified by a number that corresponds to the firing sequence. This corresponds to Plan A on the reverse side of the sample form. There is no set numbering convention for identifying blast holes, use your judgment as to what makes sense.

The collar elevation is the elevation at the top of the collar (i.e., top of the blast hole) at the ground surface. The bottom elevation is simply the bottom of the blast hole or bottom of the charge. These are identified in figure 7B.1. Note in figures 7B.1 and 7B.5 the holes are drilled some distance (S) below the desired finished grade elevation. This may be necessary because there will be unbroken rock (also known as tights or high points) between holes that extend above the bottom elevation. The upper limit of this unbroken rock increases as the distance between holes increases. A higher powder factor may reduce the amount of unbroken rock between holes but will generally fracture the rock that is to remain in place. Thus, spacing holes closer together is generally required when it is necessary to control the grade with minimal damage to rock that is to remain in place.

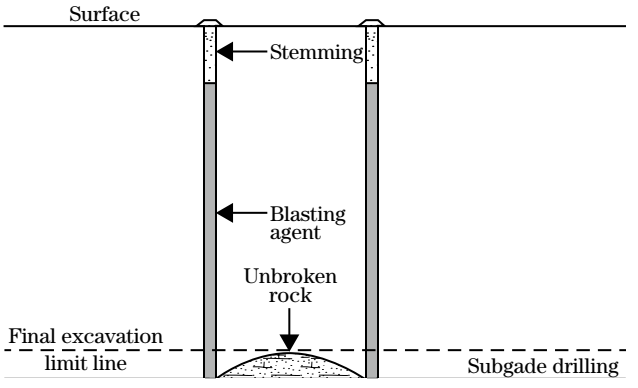
The charge may vary with hole depth. In the example used for the sample worksheet, all of the holes bottomed at the same elevation, but the ground was rising from Row 1 to Row 3. The charge required per hole is based

NEH 645 WS 7.3 Report of Blasting Operation—continued

on the amount of rock that is to be broken by the blast in that hole. This is figured by multiplying the free face height by the distance from the free face to the hole and by the hole spacing. As the blast progresses, the free face progresses back into the rock mass. In the case of Plan A, the beginning free face is represented by the heavy line in front of the blast. The first hole that fires in the middle of Row 1 breaks up the rock around it, and the free face (unconfined face) relocates in between the #1 hole and the #2 set of holes. When the holes designated #2 fire the free face relocates to in between the #2 and #3 holes, etc. For Plan A, as the ground rises the free face height increases requiring more blasting agent in the corresponding holes.

The delay period is a cumulative number. In the sample worksheet example, the hole denoted by a 1 is the POI, or point of initiation, so it has a zero delay period. The #2 holes fire next after a 10-ms delay. There is a 10-ms delay between the #2 and #3 holes, so the delay period for the #3 holes is the sum of previous delay periods (10 ms from #1 to #2 + 10 ms for #2 to #3), etc.

Figure 7B–5 Subgrade drilling



Maximum No. of holes per delay is the maximum number of holes that will ignite (detonate) at any one time. This should be stated or otherwise denoted in the blasting plan.

Maximum weight of blasting agent per delay is the maximum weight of blasting agent ignited at any one time. This should also be stated or otherwise denoted in the blasting plan. This is a significant value because an increase in this value will result in an increase in ground vibrations and air blast that may damage nearby buildings, structures, or utilities. See section 645.0701(c), Blast monitoring.

Distance, direction, and identification of nearest building, structure, or utility should be addressed when designing the blast. This value along with the rock characteristics can be used to determine the maximum weight of blasting agent per delay to avoid damage to the building, structure, or utility.

Type of material blasted should be noted in the blasting plan. The type of material being blasted must be known when designing the blast. And records of previous blasts of similar materials are valuable when designing future blasts. Good finished grade of a homogeneous rock is easier to accomplish than that of a material that is

NEH 645 WS 7.3 Report of Blasting Operation—continued

layered with materials of various hardness and density. It may be helpful to describe the material being blasted in more detail and sketch a cross section of the material if it is not homogeneous. Such details may be sketched on the back side of the worksheet or on an attached separate sheet. Note on the front of the worksheet if additional sheets are attached.

Mats or other precautions used—Mats are sometimes used to cover the blast area to prevent fly rock and reduce air blast. Mats are generally required when blasting near buildings, structures or utilities that could be damaged from fly rock or air blast. They are less likely to be required or needed on work in rural areas.

Seismograph Records where required—The information required here is self explanatory. See section 645.0701(c) for more information on blast monitoring.

Sketch on revise side of WS 7.3—The layout of blast holes should be sketched on the grid paper on the back of WS 7.3. Include a scale for measuring distances. Indicate the burden distance (B) and hole spacing (S). Include the numerical delay sequence showing when each blast hole will ignite relative to the other holes. The examples shown on the sample worksheet were taken from a document about quarry blasting. These are shown to illustrate several different blast patterns (identified as Plan A through Plan G) depending on the geometry of the area to be blasted. These are all plan views. Section views may also be helpful to fully describe the blast. Note that plan A corresponds with the sample report for Cow Bayou Site 4.

Sample NEH 645 WS 7.3

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.3 Report of Blasting Operation

Project Cow Bayou Site 4 Reported by: Earl Grey Date 1/6/2012

Time of blast 10:00 a.m. Weather conditions Dry (X) Foggy ( ) Clear (X) Cloudy ( ) Rain ( ) Snow ( )

Temperature 58 (°F) Wind direction SW Approximate wind velocity 5 (mph)

Exact location of blast 50 to 100 feet left of auxillary spillway CL sta. 3+100 to 3+40

Company A.B. Donegan, Inc. Address 349 Frisco St., Anytown, USA 76000

Name of blaster Burt Donegan Blaster's license number BR549

Blasting agent #1 and density ANFO-P 0.85 g/cm³ Powder factor 1 (lb/yd³) Dia. of holes 3 (in)

Blasting agent #2 and density _____ Powder factor _____ (lb/yd³) Dia. of holes _____ (in)

Burden/spacing 4 (ft)/ 8 (ft) Type/depth of stemming ASTM C33 sand / 6 (ft)

Method of initiation: Electric (X) Nonelectric ( ) Other _____

Delay types 10-ms caps Type of circuit, if electric Series-in-parallel

Row #	Hole I.D.	3	2	1	2	3												
1	Collar elev.	92.1	92.0	91.8	91.9	91.9												
	Bottom elev.	82.0	82.0	82.0	82.0	82.0												
	Charge (lb)	12	12	12	12	12												
	Delay period (ms)	20	10	0	10	20												
	Hole I.D.	4	3	2	3	4												
2	Collar elev.	93.3	93.1	93.0	93.1	93.1												
	Bottom elev.	82.0	82.0	82.0	82.0	82.0												
	Charge (lb)	13	13	13	13	13												
	Delay period (ms)	30	20	10	20	30												
	Hole I.D.	5	4	3	4	5												
3	Collar elev.	94.5	94.3	94.2	94.2	94.1												
	Bottom elev.	82.0	82.0	82.0	82.0	82.0												
	Charge (lb)	14	14	14	14	14												
	Delay period (ms)	40	30	20	30	40												
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	

Maximum no. of holes per delay 5 Maximum weight of blasting agent per delay 64 (lb)

Distance, direction, and identification of nearest building, structure, or utility N.A.

Type of material blasted: Limestone X Shale ____ Sandstone ____ Slate ____ Other _____

Mats or other precautions used _____

Seismograph records where required

Location of seismograph(s) used N.A.

Distance of seismograph from blast _____ Seismic data _____

Name of the person taking seismograph reading _____

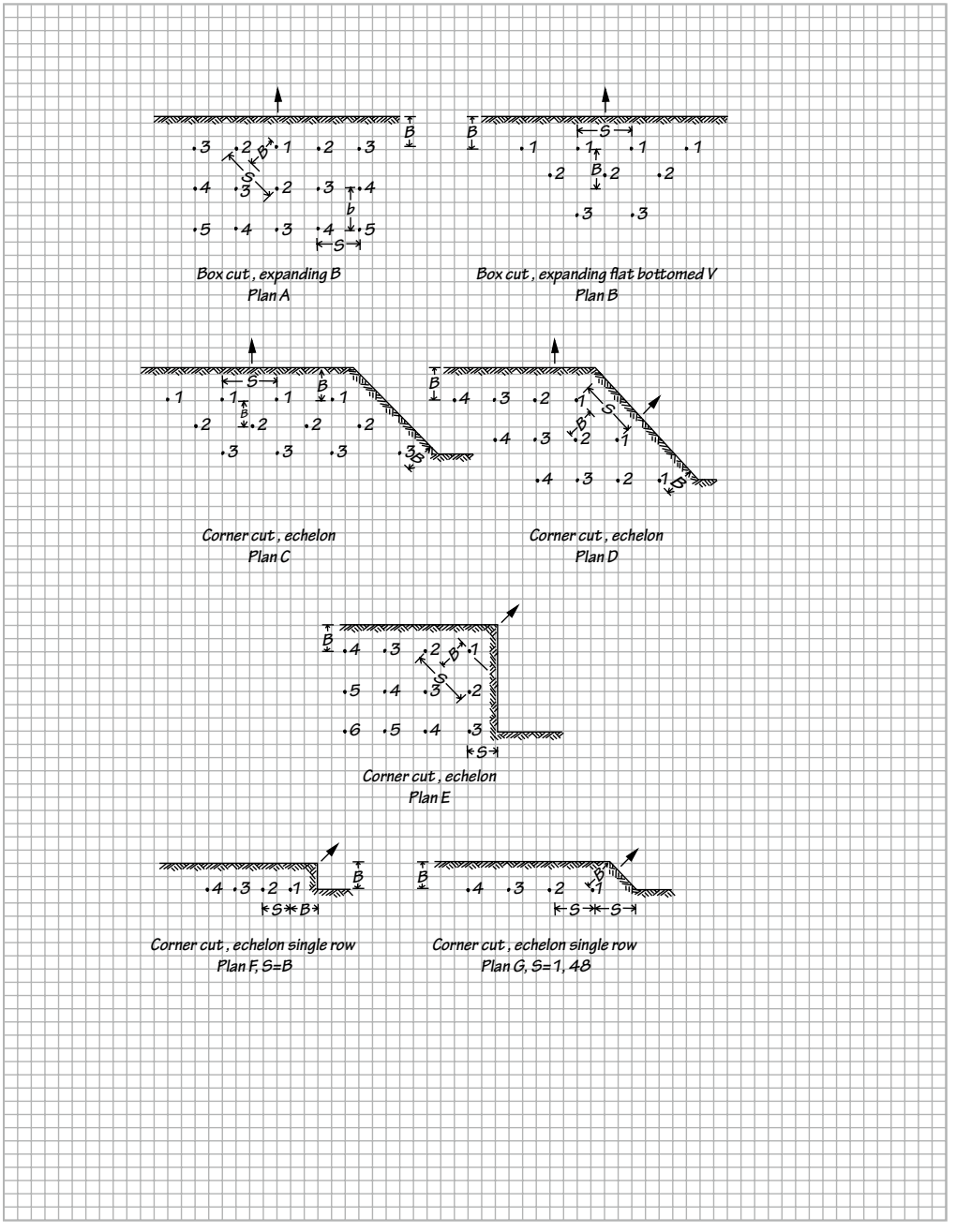
Name of the person/firm analyzing seismograph record _____

Sample NEH 645 WS 7.3—continued

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.3

Draw a sketch of the general location and layout. Include the numerical delay sequence. Show location of free faces and trend of backslope as applicable.



This page intentionally left blank.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.3 Report of Blasting Operation

Project_____ Reported by: _____Date _____

Time of blast _____ Weather conditions Dry ( ) Foggy ( ) Clear ( ) Cloudy ( ) Rain ( ) Snow ( )

Temperature _____ (^{o}F) Wind direction _____ Approximate wind velocity _____ (mph)

Exact location of blast _____

Company _____ Address _____

Name of blaster _____ Blaster's license number _____

Blasting agent #1 and density_____ Powder factor _____ (lb/yd^3) Dia. of holes _____ (in)

Blasting agent #2 and density_____ Powder factor _____ (lb/yd^3) Dia. of holes _____ (in)

Burden/spacing _____ (ft)/ _____ (ft) Type/depth of stemming _____ /_____ (ft)

Method of initiation: Electric ( ) Nonelectric ( ) Other _____

Delay types _____ Type of circuit, if electric _____

Row #	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	

Maximum no. of holes per delay _____ Maximum weight of blasting agent per delay _____ (lb)

Distance, direction, and identification of nearest building, structure, or utility _____

_____

_____

Type of material blasted: Limestone _____ Shale _____ Sandstone _____ Slate _____ Other _____

Mats or other precautions used _____

Seismograph records where required

Location of seismograph(s) used _____

Distance of seismograph from blast _____ Seismic data _____

Name of the person taking seismograph reading _____

Name of the person/firm analyzing seismograph record_____

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 7.3

Draw a sketch of the general location and layout. Include the numerical delay sequence. Show location of free faces and trend of backslope as applicable.

U.S. Department of Agriculture
Natural Resources Conservation Service

Sheet _____ of_____

NEH 645 WS 7.3 (cont.) Report of Blasting Operation (cont.)

Project _____ Reported by _____ Date _____

Row #	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	
	Hole I.D.																	
	Collar elev.																	
	Bottom elev.																	
	Charge (lb)																	
	Delay period (ms)																	

This page intentionally left blank.

NRCS–ENG–005

The NRCS–ENG–005 form is used to notify the landowner-operator or sponsoring organization of their responsibilities when buried utilities are known to be in the vicinity of proposed work. The attendant form NRCS–ENG–006 is a check sheet used to verify and document that NRCS actions related to buried utilities in the vicinity of the proposed work comply with NRCS policy.

NRCS policy set forth in the National Engineering Manual (NEM) requires the responsible NRCS employee to notify the landowner-operator or sponsoring organization if buried utilities are known to be in the vicinity of proposed work. Policy requires that they be notified of their responsibility to take the following actions:

Step 1 Notify the Utility Notification Center (i.e., One Call Center, Dig Safe, or equivalent) or the affected utility company of time, place, and type of work to be performed.

Step 2 Request that the utility owner locate and stake the buried utility on the ground, both horizontally and vertically.

Step 3 Request that a representative of the utility company be present during any excavation operations.

Step 4 Notify the contractor of the location of the utility in relation to the job work area.

Step 5 Supply to the NRCS in writing either the ticket number from the Utility Notification Center or a certification that the affected utility company has been notified. States may set up their own procedures, with the aforementioned being the minimum requirement. Failure to notify the NRCS that utilities have been contacted will result in termination of NRCS assistance.

The NEM states that the responsible NRCS employee must ensure that these steps are carried out by the landowner-operator or sponsoring organization before beginning work in the vicinity of the buried utility and document any action taken pertaining to work in the vicinity of buried utilities. Documentation may be in the job diary, conservation assistance notes, or a separate checklist.

One option for documenting these actions is completion of the NRCS–ENG–005 and NRCS–ENG-006. NRCS–ENG–005 is a notification to the landowner-operator or sponsoring organization of their responsibilities and provides a means for them to certify that they have completed the items for which they are responsible. NRCS–ENG–005 is mailed to the landowner-operator or sponsoring organization, returned to the NRCS, and filed with other documentation pertaining to work in the vicinity of the buried utility. A sample illustrating and describing the completion of the NRCS–ENG–006 is also provided in NEH 645, Appendix B.

The steps for completing NRCS–ENG–005 are:

Steps performed by the NRCS:

Step 1 Enter the name of the utility company and type of utility in the blanks provided in the paragraph above the list of responsibilities.

Step 2 Have the District Conservationist or other responsible NRCS employee sign on the line provided below the list of responsibilities.

Step 3 Fold the form so that the list of responsibilities can be seen and staple or tape the form to ensure that it remains folded in the mail.

Step 4 Address and mail the form to the landowner-operator or sponsoring organization.

NRCS–ENG–005—continued

Steps performed by the landowner-operator or sponsoring organization:

Step 1 Complete the portion listing the landowner's name and address, the name and address of the utility company, the name and title of the utility representative, etc.

Step 2 Sign and date at the bottom of the form.

Step 3 Fold the form so that the portion completed by the landowner-operator or sponsoring organization can be seen and staple or tape the form to ensure that it remains folded in the mail.

Step 4 Address and mail the form back to the originating NRCS office.

Steps performed by NRCS upon receipt of the returned form:

Step 1 Verify and document on the NRCS–ENG–006 that NRCS–ENG–005 has been completed and signed by the landowner-operator or sponsoring organization.

Step 2 File the form with other documentation pertaining to work in the vicinity of the buried utility.

Sample NRCS–ENG–005

U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ENG-005

U.S. Department of Agriculture
Natural Resources Conservation Service

Ray Handcock
Rt. 1, Box 27A
Jewett, TX 75861

OFFICIAL BUSINESS
Penalty for Private Use, $300

TO: *Mr. John Evans*
District Conservationist
USDA-NRCS
P.O. Box 101A
Centerville, TX 75902

Landowner's name *Ray Handcock*	Address *Rt. 1, Box 27A* *Jewett, TX 75861*
Utility company *XTO Energy*	Address *P.O. Box 767* *Hearn, TX 75961*
Utility representative notified (*Name*) *Elmer Justis*	Title *Public Liaison*
If Utility notified by letter, date of acknowledgement of receipt	*NA*
Utility representative will locate and stake	Yes ☑ No ☐
Utility representative will be present during construction	Yes ☐ No ☑
Contractor notified (*Name & Title*) *Larry Cordel, Owner*	Date *7/30/2012*
Owner—Operator—Sponsor (*Signature*) Ray Handcock	Date *7/30/2012*

Sample NRCS–ENG–005—continued

U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ENG-005

Dear

Because of the great hazard to life and property from the disturbance of utilities by construction or foundation investigation equipment and because the conservation work to be done on land controlled by you is in the vicinity of XTO Energy (UTILITY CO.) Gas Pipeline (TYPE OF UTILITY), before work proceeds it is your responsibility to do the following:

1. Notify the utility company of the location and kind of work to be done and the proposed date that work will start.
2. Request that the utility owner assist in locating and staking the utility on-site.
3. Request that a utility company employee be present during construction within the utility right-of-way.
4. Notify contractor of location of utility.
5. Fill out and sign the attached postcard and return to the Natural Resources Conservation Service.

John Evans
DISTRICT CONSERVATIONIST

U.S. Department of Agriculture
Natural Resources Conservation Service

P.O. Box 101A
Centerville, TX 75902

OFFICIAL BUSINESS

Ray Handcock
Rt. 1, Box 27A
Jewett, TX 75861

U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ENG-005

U.S. Department of Agriculture
Natural Resources Conservation Service

OFFICIAL BUSINESS
Penalty for Private Use, $300

TO:

Landowner's name	Address
Utility company	Address
Utility representative notified (*Name*)	Title
If Utility notified by letter, date of acknowledgement of receipt	
Utility representative will locate and stake	Yes ☐ No ☐
Utility representative will be present during construction	Yes ☐ No ☐
Contractor notified (*Name & Title*)	Date
Owner—Operator—Sponsor (*Signature*)	Date

U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ENG-005

Dear

Because of the great hazard to life and property from the disturbance of utilities by construction or foundation investigation equipment and because the conservation work to be done on land controlled by you is in the vicinity of _____,
UTILITY CO. TYPE OF UTILITY
before work proceeds it is your responsibility to do the following:

1. Notify the utility company of the location and kind of work to be done and the proposed date that work will start.
2. Request that the utility owner assist in locating and staking the utility on-site.
3. Request that a utility company employee be present during construction within the utility right-of-way.
4. Notify contractor of location of utility.
5. Fill out and sign the attached postcard and return to the Natural Resources Conservation Service.

_____
DISTRICT CONSERVATIONIST

U.S. Department of Agriculture
Natural Resources Conservation Service

OFFICIAL BUSINESS

NRCS–ENG–006, Utility Check Sheet

The NRCS–ENG–006 form is a check sheet used to verify and document that NRCS actions related to buried utilities in the vicinity of the proposed work comply with NRCS policy.

NRCS policy set forth in the National Engineering Manual (NEM) requires the responsible NRCS employee to notify the landowner-operator or sponsoring organization if buried utilities are known to be in the vicinity of proposed work. Policy requires that they be notified of their responsibility to take the following actions:

Step 1 Notify the Utility Notification Center (i.e., One Call Center, Dig Safe, or equivalent) or the affected utility company of time, place, and type of work to be performed.

Step 2 Request that the utility owner locate and stake the buried utility on the ground, both horizontally and vertically.

Step 3 Request that a representative of the utility company be present during any excavation operations.

Step 4 Notify the contractor of the location of the utility in relation to the job work area.

Step 5 Supply to NRCS in writing either the ticket number from the Utility Notification Center or a certification that the affected utility company has been notified. States may set up their own procedures, with the aforementioned being the minimum requirement. Failure to notify the NRCS that utilities have been contacted will result in termination of NRCS assistance.

The NEM states that the responsible NRCS employee must ensure that these steps are carried out by the landowner-operator or sponsoring organization before beginning work in the vicinity of the buried utility and document any action taken pertaining to work in the vicinity of buried utilities. Documentation may be in the job diary, conservation assistance notes, or a separate checklist.

One option for documenting these actions is completion of the NRCS–ENG–005 and NRCS–ENG–006. A sample illustrating and describing the completion of the NRCS–ENG–005 is also provided in NEH 645, Appendix B.

The steps for completing NRCS–ENG–006, Utility Check Sheet are:

Steps performed by NRCS:

Step 1 Upon return of the NRCS–ENG–005 or after notifying the landowner-operator or sponsoring organization by another means, begin filling out the NRCS–ENG–006. Recording the farm name, location, utilities involved and location of utilities involved, and the name of the notified landowner-operator or sponsoring organization representative. Also record how and when the landowner-operator or sponsoring organization was notified.

Step 2 Record items listed on the utility check sheet as they are completed.

Step 3 When all items on the check sheet have been completed, sign and file the form with other documentation pertaining to work in the vicinity of the buried utility.

Sample NRCS–ENG–006

U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ENG-006

UTILITY CHECK SHEET

Farm Name *Ray Handcock* Location *Leon County, Texas*

Utilities Involved and Location *Underground natural gas line*
ETO Energy Located approximately 200 feet east of excavation

Landowner or operator notified *Ray Handcock* (Who) *John Evans* (By Whom)

How *NRCS-ENG-005* Date *7/26/2012*

Work to be done *Pit-type Pond* When *8/6-9/2012*

Utility Company Notified *Elmer Jones* (Who) *Ray Handcock* (By Whom)

How *Telephone* Date *7/30/2012*

Request to locate utility *Yes*

Work to be done *Location flagged* When *8/1/2012*

Request for Company representative to be present *Yes*

Utility marked or staked *Yes* Date *8/1/2012*

Representative present during construction *No*

Contractor Notified *Larry Cordel* (Who) *Ray Handcock* (By Whom) *In person* (How) *7/30/2012* (Date)

Type of utility *Buried gas line* Location *Outside of work area*

Vertical location in relation to work *6 feet below surface*

Horizontal location in relation to work *200 feet east of exc. limits*

Contractor shown markings or stakes *Yes*

Utility location shown on plans *Yes*

Other remarks *Utility well marked. No excavation or earthfill will occur on utility right-of-way.*

John Evans
Signature

U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ENG-006

UTILITY CHECK SHEET

Farm Name _____ Location _____

Utilities Involved and Location _____

_____

Landowner or operator notified _____ _____
Who By Whom

How _____ Date _____

Work to be done _____ When _____

Utility Company Notified _____ _____
Who By Whom

How _____ Date _____

Request to locate utility _____

Work to be done _____ When _____

Request for Company representative to be present _____

Utility marked or staked _____ Date _____

Representative present during construction _____

Contractor Notified _____ _____ _____ _____
Who By Whom How Date

Type of utility _____ Location _____

Vertical location in relation to work _____

Horizontal location in relation to work _____

Contractor shown markings or stakes _____

Utility location shown on plans _____

Other remarks _____

_____

_____
Signature

This page intentionally left blank.

NEH 645 WS 13.1 Record of Aggregate Moisture

Aggregate moisture should be monitored and documented at least once each production shift and whenever a change in the moisture is suspected.

On WS 13.1, note that the fine aggregate sampled on April 30 was sampled by two different test methods with different results. The first test method, ASTM D4944, appeared to measure mostly surface moisture. The second test method, ASTM D4959, measured surface and absorbed moisture. Always note observations such as this in the comments section.

When sampling aggregate, note the time when sampling is begun and the time when sampling ceases. This will allow correlation with the plant record pertaining to the mix produced from the aggregates sampled.

Obtain several samples. Record all test results and strike through any values that are unreasonable or markedly different from other results of tests from the same set of samples. Average the test results from the remaining values in each set of samples.

Sample NEH 645 WS 13.1

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.1 Record of Aggregate Moisture

Watershed Pine Creek **Site No.** 3 **Structure** Aux. Spillway **Report No.** 3 of 28

Inspector R.. Rangel

Coarse Aggregate #1 Redland crushed 1" NMSA **Fine Aggregate #1** Redland silica sand

Coarse Aggregate #2 Lakeside Pit #2 **Fine Aggregate #2**

Date	Time Sampled		Aggregate Tested	Specific Location Tested	Test Method	Test Results						Average
	Start	End				Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	
4/30/05	1000	1100	FA #1	Stockpile *	D4944	2.0	2.0	2.2	2.1			2.1
4/30/05	1000	1100	FA #1	Stockpile *	D4959	2.5	2.5	2.7	2.6			2.6
5/1/05	0815	0830	CA #1	End of belt #1	D4959	2.4	2.6	2.5				2.5
5/1/05	0830	0845	CA #2	End of belt #2	D4959	2.5	2.4	2.5				2.5
5/1/05	0845	0900	FA #1	End of belt #3	D4959	2.3	2.2	2.4				2.3
5/2/05	0815	0830	CA #1	End of belt #1	D4959	2.5	2.6	2.6				2.6
5/2/05	0830	0845	CA #2	End of belt #2	D4959	~~2.2~~	2.7	2.7	2.6			2.7
5/2/05	0915	0930	FA #1	End of belt #3	D4959	2.1	2.1	2.2	2.1			2.1
5/3/05	0800	0815	CA #1	End of belt #1	D4959	~~2.2~~	2.7	2.7	2.8			2.7
5/3/05	0815	0830	CA #2	End of belt #2	D4959	2.7	~~2.3~~	2.8	2.8			2.8
5/3/05	0845	0900	FA #1	End of belt #3	D4959	2.2	2.3	2.3	2.4			2.3

Comments:
*FA was taken at various locations where material was being removed by front end loader. Speedy moisture meter appears to be measuring free water only. Tests on 4/30 were made from the same sample, but the oven dry sample test results show approximately 0.5 percent more moisture than the speedy. A calibration curve will be developed for the Speedy.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.1

Record of Aggregate Moisture

Watershed _____ **Site No.** ___ **Structure** _____ **Report No.** ___ _____

Inspector _____

Coarse Aggregate #1 _____ **Fine Aggregate #1** _____

Coarse Aggregate #2 _____ **Fine Aggregate #2** _____

Date	Time Sampled		Aggregate Tested	Specific Location Tested	Test Method	Test Results						Average
	Start	End				Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	

Comments:

This page intentionally left blank.

NEH 645 WS 13.2 Field Mix Evaluation

Plants that produce RCC also produce a plant record listing the weight of individual ingredients being mixed at any time during production. The inspector must ensure that the mix being produced in the field conforms to the approved Job Mix. The Field Mix Evaluation uses information obtained from the Job Mix submittal and plant records to evaluate the mix being produced in the field (field mix). Three questions about the field mix are answered by the completion of the Field Mix Evaluation:

- Is the field mix proportioned within the tolerances specified in Spec 36?
- What is the *percent moisture* (%M) of the field mix?
- What is the theoretical air-free density (TAFD) of the field mix?

Enter the applicable units (pounds or tons) in the space provided in the top left corner of the table. Use the units reported by the plant. The values in the example are in tons.

Line 1
Record the quantities of each mix ingredient on line 1, columns 1 through 7 and column 9. The sum of the figures in columns 1 through 7 is computed and placed in column 8. In the example, the quantities are summed as follows:

$$25.99 + 45.23 + 59.25 + 5.76 + 6.49 + 4.50 = 147.22 \text{ tons}$$

Column 9
Column 9 contains information about the admixture. The example shows 570 ounces of admixture were added to the mix. For a liquid admixture, this equals approximately 37 pounds of liquid, which is included in the quantity for Water + Admix in line 1, column 5. If the plant record does not include the admixture in the quantity of water added to the mix, add the quantity of admixture to the quantity of water reported by the plant and place this sum in line 1, column 5.

Line 2, columns 1 through 4
The value for aggregate field moisture is obtained from the Record of Aggregate Moisture and placed in line 2, columns 1 through 4. For coarse aggregate #1 (CA #1) the value of 2.5 percent is obtained from the Record of Aggregate Moisture and recorded on line 2, column 1.

Line 3, columns 1 through 4
Use the field moisture from line 2 to compute the weight of dry aggregate. For example, the Dry Quantity of CA #1 is computed as follows:

$$\text{Dry Quantity} = \frac{25.99}{1.025} = 25.36 \text{ tons}$$

Line 2, column 5
The difference between the quantity in line 1, columns 1 through 4 and the dry quantity in line 3, columns 1 through 4 equals the aggregate moisture. For CA #1, the aggregate moisture is computed as follows:

$$25.99 - 25.36 = 0.63 \text{ tons}$$

The sum of the aggregate moisture is entered in line 2, column 5. In the example, this value is computed as follows:

$$\text{Field Moisture} = 0.63 + 1.10 + 1.33 = 3.06 \text{ tons}$$

NEH 645 WS 13.2 Field Mix Evaluation—continued

Line 3, column 5
The total amount of moisture in the mix is determined by adding the value in line 1, column 5 to that in line 2, column 5 as follows:

$$5.76 + 3.06 = 8.82 \text{ tons}$$

Place this value in line 3, column 5.

Line 4, columns 1 through 4
Some of the moisture in the mix is absorbed by the aggregates. The amount of moisture that an aggregate will absorb is termed "*absorption*." Aggregate absorption is determined in the laboratory and reported as a percentage of the dry weight of the aggregate. Spec 36 requires aggregate absorption to be reported on the Job Mix submittal for each aggregate used in the mix. Obtain the absorption from the Job Mix submittal and record the values for each aggregate in line 4, columns 1 through 4, as applicable. In the example, in line 4, column 1, 2.0 percent is recorded as the absorption of CA #1.

Line 5, columns 1 through 4
The *saturated surface-dry (SSD)* quantity is the weight of the aggregates plus the moisture absorbed into the aggregates. Compute the SSD quantity for each aggregate using the value for absorption from line 4. The SSD quantity of CA #1 is computed as follows:

$$\text{SSD Quantity} = 25.36 \times 1.02 = 25.87 \text{ tons}$$

Place the value for SSD quantity of each aggregate in the appropriate column on line 5.

Line 4, column 5
The amount of moisture absorbed by each aggregate is computed by subtracting the dry quantity in line 3, columns 1 through 4 from the SSD quantity in line 5, columns 1 through 4. For example, the amount of moisture absorbed by CA #1 is computed as follows:

$$25.87 - 25.36 = 0.51 \text{ tons}$$

The total aggregate absorption is computed as follows:

$$\text{Total Absorption} = 0.51 + 0.93 + 0.29 = 1.73 \text{ tons}$$

Enter the total absorption on line 4, column 5.

Line 5, column 5
The difference between the total amount of moisture in the mix and the total absorption is termed the "*free water*." The free water is the moisture that is available (free) to mix with the cementitious materials and other fine particles to form the paste. In the example, the free water is computed as follows:

$$\text{free water} = 8.82 - 1.73 = 7.09 \text{ tons}$$

Enter the free water on line 5, column 5.

NEH 645 WS 13.2 Field Mix Evaluation—continued

Line 5
Copy the quantities of cement and pozzolan from line 1, columns 6 and 7 to line 5, columns 6 and 7. The sum of the values on line 5, columns 1 through 7 equals the total weight of the mix as follows:

$$25.87 + 45.06 + 58.21 + 7.09 + 6.49 + 4.50 = 147.22 \text{ tons}$$

This value is placed on line 5, column 8 and must equal the previous total located on line 1, column 8. If these values are not equal, a computation error has occurred that must be corrected before proceeding.

Line 6, columns 1 through 7
Line 6 contains the quantity of each ingredient as a percentage of the total mix quantity. The values in line 6, columns 1 through 7 are computed by dividing the values in line 5 by the total quantity of the mix on line 5, column 8 and multiplying by 100. For example, the percentage of CA #1 is computed as follows:

$$\left(\frac{25.87}{147.22}\right) \times 100 = 17.57\%$$

Line 6, column 9
Copy the quantity of admixture added to the mix from line 1, column 9.

Line 7, columns 1 through 7
From the Job Mix, record the specified percentage of each aggregate, water + admixture, cement, and pozzolan.

Line 7, column 9
Record the quantity of admixture specified in the Job Mix on line 7, column 9. This value may be shown on the Job Mix in ounces or milliliters per cubic yard of mix. If so, it must be multiplied by the number of cubic yards in the batch being evaluated to convert to ounces or milliliters per batch.

Line 8
Compute and record the percent difference between the values in lines 6 and 7. For example, line 6, column 1 shows 17.57 percent of the mix is CA #1. The Job Mix specified that 17.43 percent of the mix be CA #1, as shown in line 7, column 1. The percent difference is computed as follows:

$$\left[\left(\frac{(17.57 - 17.43)}{17.43}\right) \times 100\right] = +0.80\%$$

Line 9
Line 9 lists the tolerances in proportioning allowed by Spec 36. The values in line 8 must be within these specified tolerances; otherwise, mix proportioning adjustments must be made so that the mix being produced in the field is proportioned within the specified tolerances.

Line 10
Copy the quantities from line 5 to line 10. The values in line 10 must be in pounds. Make the conversion, if applicable. For example, the quantity of CA #1 on line 5 is 25.87 tons. The value recorded on line 10, column 1 is computed as follows:

$$25.87 \text{ tons} \times 2000 \text{ lb/ton} = 51{,}740 \text{ lb}$$

NEH 645 WS 13.2 Field Mix Evaluation—continued

The sum of values in line 10, columns 1 through 7 equals the total weight of the mix in pounds as follows:

$$51,740 + 90,120 + 116,420 + 14,180 + 12,980 + 9,000 = 294,440 \text{ lb}$$

Record this value on line 10, column 8.

Line 11

Obtain from the Job Mix the SSD relative density of each of the ingredients, and record them on line 11, columns 1 through 7. (Note: Relative density is the ratio of the weight of a specific absolute volume of material to the weight of an equal volume of distilled water. It is synonymous with the term "specific gravity" and is sometimes reported on Job Mix submittals as specific gravity, or abbreviated G_s). The aggregate relative densities recorded here are for aggregates in the saturated surface dry (SSD) condition. Aggregate relative density should be listed on the Job Mix for aggregates in the SSD condition. If the relative density listed on the Job Mix submittal has not been adjusted for SSD, make the adjustment. For example, if the relative density of CA #1 in the dry condition is 2.60 and the absorption is 2.0 percent, the SSD relative density is computed as follows:

$$2.60 \times 1.02 = 2.65$$

Line 12

Compute and record the *absolute volume* of each mix ingredient on line 12, columns 1 through 7. The absolute volume computation is made by dividing the values in line 10, columns 1 through 7 by the product of values in line 11, columns 1 through 7 and the unit weight of water. For example, the *absolute volume* of CA #1 is computed as follows:

$$\text{Absolute Volume} = \frac{51,740}{(2.65 \times 62.4)} = 312.89 \text{ ft}^3$$

Compute, as follows, the sum of the absolute volumes of each ingredient and place in line, 12 column 8:

$$312.89 + 538.89 + 704.04 + 227.24 + 66.04 + 51.15 = 1,900.25 \text{ ft}^3$$

The %M and TAFD computations are made at the bottom of the worksheet. %M is computed by dividing the total weight of dry materials in the mix by the total moisture in the mix. In the example, the %M is computed as follows:

$$\%M = \left[\frac{8.82}{(147.22 - 8.82)}\right] \times 100 = 6.4\%$$

TAFD is computed by dividing the total weight of all ingredients in the mix by the absolute volume of all ingredients in the mix as follows:

$$\text{TAFD} = \frac{294,440 \text{ lb}}{1,900.25 \text{ ft}^3} = 155.0 \text{ lb/ft}^3$$

Sample NEH 645 WS 13.2

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.2 Field Mix Evaluation

Watershed Pine Creek **Site No.** 3 **Structure** Aux. Spillway **Report No.** 3 **of** 28 **Date** 4/1/05
Placement No. or Location Test Section **Inspector** R. Rangel
Time of operation 0800 **to** 1130 **Weather** Cloudy, cool **Temp** 49 °F **to** 55 °F
RCC Temp 53 °F **to** 55 °F **Plant brand** ARAN 280 **Plant type** Continuous flow through pug mill
Mix Number PC3 200/100 **Cement Source and Type** Lehigh Type I **Pozzolan Source and Class** Monex Class F
Admixture Source and Type MB ASTM C494 Type D
Coarse Aggregate #1 Redland crushed 1" NMSA **Fine Aggregate #1** Redland manufactured sand
Coarse Aggregate #2 Lakeside Pit #2 **Fine Aggregate #2**

	Column →	1	2	3	4	5	6	7	8	9
Line	Unless Otherwise Indicated Units = ____ tons	CA #1	CA #2	FA #1	FA #2	Water + Admix	Cement	Pozzolan	Total	*Admixture (__oz__)
1	Quantity	25.99	45.23	59.25		5.76	6.49	4.50	147.22	570
2	Field Moisture	2.5 %	2.5 %	2.3 %	%	3.06				
3	Dry Quantity	25.36	44.13	57.92		8.82				
4	Absorption	2.0 %	2.1 %	0.5 %	%	1.73				
5	SSD Quantity	25.87	45.06	58.21		7.09	6.49	4.50	147.22	
6	Proportions (%)	17.57	30.61	39.54		4.82	4.41	3.06	**100**	570
7	Job Mix (%)	17.43	31.07	39.30		4.73	4.37	3.10	**100**	563
8	Difference ± (%)	+0.80	1.48	+0.61		+1.90	+0.92	1.29		+1.24
9	Tolerance (%)	± 3	± 3	± 3	± 3	± 2	± 2	± 2		± 3
10	SSD Quantity (lbs)	51,740	90,120	116,420		14,180	12,980	9,000	294,440	
11	SSD Relative Density	2.65	2.68	2.65		1.0	3.15	2.82		
12	Absolute Volume (ft^3)	312.89	538.89	704.04		227.24	66.04	51.15	1,900.25	

$$\%M = \left[\frac{8.82}{(147.22 - 8.82)}\right] \times 100 = 6.4\%$$

$$TAFD = \frac{294{,}440 \text{ lb}}{1{,}900.25 \text{ ft}^3} = 155.0 \text{ lb/ft}^3$$

This page intentionally left blank.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.2 Field Mix Evaluation

Watershed _____ Site No. __ Structure _____ Report No. ___of___ Date_____
Placement No. or Location _____ Inspector _____
Time of operation_____ to_____ Weather_____ Temp _____ to _____
RCC Temp _____to _____ Plant brand _____Plant type _____
Mix Number _____ Cement Source and Type_____ Pozzolan Source and Class_____
Admixture Source and Type _____
Coarse Aggregate #1 _____ Fine Aggregate #1 _____
Coarse Aggregate #2 _____ Fine Aggregate #2 _____

	Column →	1	2	3	4	5	6	7	8	9
Line	Unless Otherwise Indicated Units = ____ tons	CA #1	CA #2	FA #1	FA #2	Water + Admix	Cement	Pozzolan	Total	*Admixture (__oz__)
1	Quantity									
2	Field Moisture	%	%	%	%					
3	Dry Quantity									
4	Absorption	%	%	%	%					
5	SSD Quantity									
6	Proportions (%)								100	
7	Job Mix (%)								100	
8	Difference ± (%)									
9	Tolerance (%)	± 3	± 3	± 3	± 3	± 2	± 2	± 2		± 3
10	SSD Quantity (lbs)									
11	SSD Relative Density									
12	Absolute Volume (ft^3)									

This page intentionally left blank.

NEH 645 WS 13.3 Apparent Maximum Density (AMD) Determination

An AMD determination must be made for each gauge employed for the purpose of documenting compliance with density specifications. The three-step process of determining the AMD should be recorded on the worksheet. Refer to NEH 645.1301(c), Test section, for a detailed explanation of this three-step process.

Sample NEH 645 WS 13.3

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.3 Apparent Maximum Density (AMD) Determination

Watershed Pine **Site No.** 3 **Structure** Aux. Spillway
Date 4/1/05 **Inspector** R. Rangel
Placement No. or Location Test Section
Time of operation 0800 **to** 1130 **Weather** Cloudy, cool
Temp 49 °F **to** 55 °F **RCC Temp** 53 °F **to** 55 °F
Mix Number PC3 200/100 **TAFD** 155.0 pcf
Roller make and model Dynapac CA511D

Step 1: Compact and test two passes beyond the point density ceases to increase.

Number of Roller Passes	Wet Density @ 12-inch depth (pcf)	
	#1 – Gauge 00103	#2 – Gauge 02103
2	148.2	148.1
3	148.7	148.5
4	149.1	149.0
5	149.5	149.5
6	149.5	149.4
7	149.4	149.4
8	149.1	149.0

Step 2: Verify that density varies no more than 2 percent from bottom to top of the 12-inch lift.

Nuclear Probe Depth (inches)	Wet Density (pcf)			
	#1 – Gauge 00103	#2 – Gauge 02103	Max. and Min.	
2	150.2	150.5	150.2	150.5
4	150.1	150.1		
6	149.9	150.1		
8	149.9	150.0		
10	149.7	149.8		
12	149.5	149.5	149.5	149.5
		Max. – Min. =	0.7	1.0
		Percent Variation = [(Max. – Min.) ÷ Max.] × 100 =	0.5%	0.7%
		Allowable Percent Variation =	2%	

Step 3: Compute the AMD.

Location	Wet Density @ 10-inch depth (pcf)			
	Gauge 00103	Gauge 02103	values ≥ 0.96TAFD	
			Gauge 00103	Gauge 02103
1	152.4	152.1	152.4	152.1
2	152.4	152.5	152.4	152.5
3	152.6	152.8	152.6	152.8
4	152.7	152.3	152.7	152.3
5		152.6		152.6
6	152.4	152.9	152.4	152.9
		Average Density =	152.5	152.6
		0.98TAFD =	151.9	
		Average Density ≥ 0.98TAFD?	Yes or ~~No~~	Yes or ~~No~~
		AMD =	152.5	152.6

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.3 Apparent Maximum Density (AMD) Determination

Watershed _____ **Site No.** ____ **Structure** _____

Date _____ **Inspector** _____

Placement No. or Location _____

Time of operation _____ **to** _____ **Weather** _____

Temp _____ **to** _____ **RCC Temp** _____ **to** _____

Mix Number _____ **TAFD** _____

Roller make and model _____

Step 1: Compact and test two passes beyond the point density ceases to increase.		
Number of Roller Passes	Wet Density @ 12-inch depth (pcf)	
	#1 – Gauge _____	#2 – Gauge _____
2		
3		
4		
5		
6		
7		
8		

Step 2: Verify that density varies no more than 2 percent from bottom to top of the 12-inch lift.				
Nuclear Probe Depth (inches)	Wet Density (pcf)			
	#1 – Gauge _____	#2 – Gauge _____	Max. and Min.	
2				
4				
6				
8				
10				
12				
Max. – Min. =				
Percent Variation = [(Max. – Min.) ÷ Max.] × 100 =				
Allowable Percent Variation =			2%	

Step 3: Compute the AMD.				
Location	Wet Density @ 10-inch depth (pcf)			
	Gauge _____	Gauge _____	values ≥ 0.96TAFD	
			Gauge _____	Gauge _____
1				
2				
3				
4				
5				
6				
Average Density =				
0.98TAFD =				
Average Density ≥ 0.98TAFD?			Yes or No	Yes or No
AMD =				

This page intentionally left blank.

NEH 645 WS 13.4 RCC Lift Summary

WS 13.4, RCC Lift Summary, is used to document placement of one RCC lift including the condition of the lift and edge joints and the treatment of those joints at the time they are covered with RCC or conventional concrete. The worksheet is also used to document moisture and density test results, the location of the tests including lift elevation, and the compactor used to compact the lift being tested.

Draw a sketch in the space provided above the table. Include items such as:

- coordinates or stations and offsets relative to the centerline of the structure that pinpoint the location of the sketched area
- embankment contact locations
- edge joint locations
- locations where temperature of the lift surface was measured and the average surface temperature (AST) as defined in Spec 36
- the time when RCC was spread over the surface
- the time when compaction was completed
- locations of moisture and density tests
- areas where there were problems with the mix
- repair areas

The joints in the example are labeled A, B, C, D, and E. A is located from approximate Station 5+70 to the end of the wall. RCC placement began over A at 8:08 a.m. RCC compaction was completed over A by 8:28 a.m. A moisture/density test was made at the location identified by the "+" and labeled "1." RCC spreading over B was completed at 8:30 a.m., apparently placed and spread while the RCC over A was being compacted.

Information to be recorded in the table includes details about the lift and RCC compaction. Spec 36 requires the RCC surface temperature to be measured each hour the lift surface is exposed. The time of joint exposure (TE) and the average temperature of the surface (AST) are recorded for each area. The product of these values equals the joint maturity. Two hours was recorded for the TE for area A. The AST for area A was recorded as 69 °F. The joint maturity is computed as follows:

$$\text{Joint maturity} = 2 \times 69 = 138 \text{ °F-hr}$$

Spec 36 defines three joint conditions (fresh joint, intermediate joint, and cold joint). One of three treatment methods defined in Spec 36 (treatment methods I, II, or III) is typically chosen by the design engineer based on the joint condition. Area A has a joint condition of "fresh." Treatment method I is recorded as the method of treatment employed to treat area A.

The moisture and density of the RCC compacted with the CA511D compactor was tested at the location identified on the sketch by "+" and labeled "1." In addition to being identified on the sketch, the test location is further defined in the table as being at Station 5+85, 176 feet left of the centerline of the structure. (Note: Unless otherwise noted, it is normal convention for the left side of the structure to be on the left when facing downstream in the direction of ascending station numbers.) A density of 149.4 pounds per cubic foot was tested with Gauge No. 00103 at a probe depth of 12 inches. 5.9 percent moisture was measured at the same location.

Include, in the comment section, any problems or relevant issues, such as a description of any repairs, which warrant additional explanation.

Sample NEH 645 WS 13.4

U.S. Department of Agriculture
Natural Resources Conservation Service

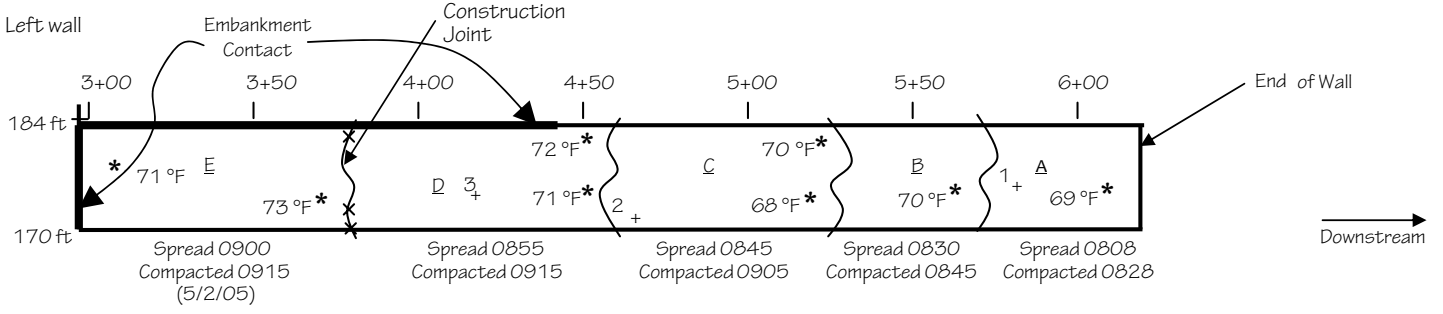
NEH 645 WS 13.4 RCC Lift Summary

Watershed Pine Creek **Site No.** 3 **Structure** Aux. Spillway **Report No.** 3 **of** 28 **Date** 5/1/05

Placement No. or Location Elev. to 730.1 to 731.1 **Mix Number** PC 200/1003 **Inspector** R. Rangel

Weather Cloudy, cool **Temp** 51 °F **to** 56 °F **Mix Temp** 65 °F **to** 73 °F

Lift Diagram Left wall



Area	A	B	C	D	E
TE (h)	2	2	2	2	17
AST (°F)	69	70	71	72	73
Joint Maturity (°F-h)	138	140	142	144	1241
Joint Condition	fresh	fresh	fresh	fresh	intermediate
Treatment Method	I	I	I	I	III
Test No.	1		2	3	
Compactor	CA511D		3410	CA511D	
Station	5+85		4+65	4+20	
Offset (ft)	L176		L171	L175	
Gauge No.	00103		00103	00103	
Moisture Content (%)	5.9		5.9	5.9	
Wet Density (lb/ft³)	149.4		148.3	149.6	
Probe Depth (in)	12		12	6	

Comments:

A problem with mix uniformity was observed during placement in Area E. A portion of the mix was removed/wasted after being deposited. Edge of remaining RCC trimmed to a 1:1 slope. Production ceased for the day. Problem was with a leaky valve dumping too much water into the mix. Problem was fixed. Production resumed on 5-2-05. Construction joint and lift joint kept moist. Construction joint and lift joint treated with Treatment Method III.

Test No. 2 was made of RCC compacted in 6-inch lifts.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.4

RCC Lift Summary

Watershed _____ **Site No.** ___ **Structure** _____ **Report No.** ____ **of** ____ **Date** _____

Placement No. or Location _____ **Mix Number** **Inspector** _____

Weather _____ **Temp** _____ **to** _____ **Mix Temp** _____ **to** _____

Lift Diagram

Area	A	B	C	D	E	Comments:
TE (h)						
AST (°F)						
Joint Maturity (°F-hr)						
Joint Condition						
Treatment Method						
Test No.						
Compactor						
Station						
Offset (ft)						
Gauge No.						
Moisture Content (%)						
Wet Density (lb/ft^3)						
Probe Depth (in)						

This page intentionally left blank.

NEH 645 WS 13.5 In-place RCC Density and Moisture Test Results

WS 13.5, In-place Density and Moisture Test Results, is used to record density and moisture test results.

Even though some information will be duplicated by using both the RCC Lift Summary and In-place Density and Moisture Test Results worksheets, a more comprehensive set of data will be provided by completing both forms.

The test location can be identified by x, y, z—coordinates or by station, offset, and elevation. The stations given in the example entries refer to the centerline station of the RCC structure. The offset (e.g., L176 ft) gives the distance to the left or right of the centerline of the RCC structure. The "L" indicates the test location is to the left of the centerline and the number 176 is the distance left of the centerline. (Note: Unless otherwise noted it is normal convention for the left side of the structure to be on the left when facing downstream in the direction of ascending station numbers.) The elevation given for the test location is the elevation of the surface upon which the nuclear gauge sits to make the test.

All nuclear gauges are identified by a number and this number should be recorded to document which gauge was used to run the test. The nuclear gauge probe is lowered into the RCC and locked at a specific depth to run the test. This depth must be recorded.

The first line in the example shows a test was made on the 1st of May at a location 176 feet left of RCC structure centerline station 4+20. Gauge number 00103 measured the wet density of the RCC to be 159.1 pounds per cubic foot with the probe set at 12 inches. The moisture was measured to be 5.8 percent. The first line also documents that the density of the 12-inch lift was attained with 10 passes of the Hamm 3410 compactor (compactor B). Furthermore, a foot note was provided that directs the reader to the Comments section of the worksheet, where it is noted that a switch was made to compactor A.

Always list corrective actions in the comment area provided at the bottom of the page and document problems and corrective actions in the job diary as appropriate.

Sample NEH 645 WS 13.5

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.5 In-Place RCC Density and Moisture Test Results

Watershed Pine Creek **Site No.** 3 **Structure** Auxiliary Spillway

Sheet No. 3 **of** 28 **Year** 2005 **Inspector** R. Rangel

Mix Number PC3-200/100 **Specified Wet Density (lb/ft³)** 149.3 **Job Mix Moisture (%)** 5.9

Compactor	Make	Model
A	Dynapac	CA511D
B	Hamm	3410
C	Wacker	RD 2700100

Date Tested	Test Location			Gauge No.	Test Depth (in)	Wet Density (lb/ft³)	Moisture (%)	Compactor	Passes	Lift Thickness (in)	Comment or Corrective Action Taken
	Station (X)	Offset (Y)	Elev. (Z)								
5/1	4+20	L176 ft	731.1	00103	12	146.1	5.8	B	10	12	1
5/1	4+20	L176 ft	731.1	00103	12	149.4	5.9	A	6	12	
5/1	4+65	L171 ft	731.1	00103	12	146.7	6.0	B	10	12	2
5/1	4+65	L171 ft	731.1	00103	6	148.3	5.8	B	6	6	
5/1	5+40	L174 ft	731.1	00103	12	149.5	5.9	A	6	12	
5/1	5+40	L174 ft	731.1	00103	10	149.7	5.9	A	6	12	
5/1	5+40	L174 ft	731.1	00103	8	150.1	5.9	A	6	12	
5/1	5+40	L174 ft	731.1	00103	6	150.5	5.9	A	6	12	
5/1	5+40	L174 ft	731.1	00103	4	150.9	5.9	A	6	12	
5/1	5+85	L176 ft	731.1	00103	12	149.6	5.9	A	6	12	
5/2	4+40	R173 ft	732.1	00103	10	149.7	5.9	A	6	12	
5/2	5+10	R176 ft	732.1	00103	10	149.6	5.9	A	6	12	
5/2	5+50	R180 ft	732.1	00103	10	149.8	5.9	A	6	12	3
5/2	5+50	R180 ft	732.1	00111	10	149.6	5.1	A	6	12	3
5/2	5+60	R176 ft	732.1	00103	10	149.9	5.9	A	6	12	3
5/2	5+60	R176 ft	732.1	00111	10	149.7	5.1	A	6	12	3

Comments:
1. Switched to Compactor A
2. Thinned lift from 12 to 6 inches when using Compactor B
3. Measurements taken in same holes with different gauges to compare gauges. Density is relatively close, but moisture varies quite a bit between gauges. Moisture correction dialed into Gauge 00103, but no correction dialed into Gauge 00111. Will determine moisture correction for Gauge 00111 prior to further use.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.5 In-Place RCC Density and Moisture Test Results

Watershed _____ **Site No.** _____ **Structure** _____

Sheet No. ____ **of** _____ **Year** _____ **Inspector** _____

Mix Number _____ **Specified Wet Density (lb/ft³)** _____ **Job Mix Moisture (%)** ____

Compactor	Make	Model
A		
B		
C		

Date Tested	Test Location			Gauge No.	Test Depth (in)	Wet Density (lb/ft³)	Moisture (%)	Compactor	Passes	Lift Thickness (in)	Comment or Corrective Action Taken
	Station (X)	Offset (Y)	Elev. (Z)								

Comments:

This page intentionally left blank.

NEH 645 WS 13.6 RCC Compressive Strength Test Results

WS 13.6, RCC Compressive Strength Test Results, is used to record information about RCC compressive strength test specimens.

The example shows the results from three groups of specimens. Groups 11 and 12 each contained 12 cylinders. The specimens in groups 11 and 12 were 6-inch nominal diameter cylinders made on 5/1/05 and 5/2/05, respectively. Two cylinders from each group were tested and are reported in the example. Group 3, made on 5/2/05, was a group of four 6-inch nominal diameter cores. Results from two of the four cores are reported in the example.

The cylinders were weighed immediately after being made to obtain their wet weight. The ends of the cores were sawed and weighed at the time of testing. Specimen volumes were determined at the time of compression strength testing.

RCC cylinders generally have a slightly larger diameter than conventional concrete test specimens because compaction results in expansion of the plastic specimen mold. Thus, the volume will be slightly higher than the volume of the empty mold. The diameter of core specimens can also vary. Accurate diameter measurements are made by measuring the circumference with a "PI tape," which yields a direct reading of the diameter to within 0.001 inch. The diameter used to compute the volume of core or molded cylinder specimens should be the average of the bottom, middle, and top diameters. The diameter of specimen number 1 from group 11 was measured near the bottom, middle, and top to be 6.009, 6.014, and 6.015 inches. The average diameter is computed as follows:

$$\frac{(6.009 + 6.014 + 6.015)}{3} = 6.013 \text{ in}$$

The cross-sectional area of specimen number 1 from group 11 is computed as follows:

$$\pi \times \frac{6.0132}{4} = 28.397 \text{ in}^2$$

The length of specimen number 1 from group 11 was measured to be 11.94 inches. The volume of the specimen is computed as follows:

$$11.94 \times \frac{28.397}{1728} = 0.1962 \text{ ft}^3$$

Density values are computed by dividing the weight of cores or cylinders by their volume. The density of specimen number 1 from group 11 is computed as follows:

$$\text{Density} = \frac{29.35 \text{ lb}}{0.1962 \text{ ft}^3} = 149.6 \text{ lb/ft}^3$$

The average density of specimen numbers 1 and 2 is computed as follows:

$$\text{Average Density} = 149.6 + 149.3 = 149.5 \text{ lb/ft}^3$$

Accurate compression testing requires the load placed on the specimen to be evenly distributed across the top and bottom of the specimen. Since the top and bottom of specimens are rarely smooth, they are capped with sulfur which is bonded to the top and bottom of the specimen or capped with a high density rubber which is not bonded to the specimen. The type of caps used, bonded or unbonded, should be reported.

NEH 645 WS 13.6 RCC Compressive Strength Test Results—continued

L/D is the ratio of the length to the diameter of the specimen. It is not uncommon for cores to have an L/D less than or equal to 1.75. ASTM C39 and C42 require a correction be made to the measured compressive strength if the L/D is less than or equal to 1.75. Correction factors taken from C39 and C42 are as follows:

L/D	Correction factor
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.87

Use interpolation to determine correction factors for L/D values given in the table.

Specimen number 1 from group 3 had an L/D of 1.67. The correction factor for this specimen is between 0.96 and 0.98. The following relationship can be employed to compute the correction factor:

$$\frac{1.75-1.67}{1.75-1.50}=\frac{0.98-x}{0.98-0.96}$$

Solve for the correction factor (x) as follows:

$$x=0.98-\left(\frac{0.08\times 0.02}{0.25}\right)\approx 0.97$$

The compressive strength of specimen number 1 from group 3 tested to be 1,920 pounds per square inch. The corrected compressive strength is computed as follows:

$$1920\times 0.97=1862\ \text{lb/in}^2$$

ASTM C39 requires compressive strength be reported to the nearest 10 pounds per square inch. Thus, in the example, the corrected compressive strength of specimen number 1 from group 3 was reported as 1,860 pounds per square inch.

ASTM C39 contains a schematic of six fracture patterns (type 1 through type 6). The number corresponding to the type of fracture should be documented. Also, note the presence of large air voids, evidence of segregation, whether fractures pass predominantly around or through coarse aggregate particles, and any other observations related to strength values attained. In the example, specimen number 12 from group 12 had a tested compressive strength of 1,410 pounds per square inch, whereas specimen number 11 made and tested on the same dates had a much higher strength (2,230 lb/in^2). A comment was made in the comments section of the worksheet explaining that poor compaction was indicated by gravel with little paste at an approximated depth of 8 inches. The comment infers the low strength was a result of poor compaction.

Spec 36 requires that three cylinders or two cores be tested for compressive strength at each age specified. The average of three cylinders or two cores made from the same mix and tested on the same day represents the mix strength at a specific age. If one compression test value is significantly lower than that of the other specimen(s), only the higher values should be used to determine the average density. If the cause of the low strength value can be determined, it should be noted as mentioned above for specimen number 12 from group 12. The strength of this specimen was recorded and then lined through to denote that it was not used to compute the average strength.

NEH 645 WS 13.6 RCC Compressive Strength Test Results—continued

The last line of the table in the RCC Compressive Strength Test Results worksheet is used to record the average compressive strength from results of two or more tests made from the same specimen group tested on 5/15/05. For example, specimens 1, 2, and 3 were in specimen group 11 and were tested on 5/15/05. Their compressive strengths are averaged as follows:

$$1580 + 1620 + 1550 = 1580 \text{ lb/ft}^2$$

This value is recorded on the last line in one of the columns containing the 5/15/05 test results from a group 11 specimen.

Sample NEH 645 WS 13.6

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.6 RCC Compressive Strength Test Results

Watershed Pine Creek **Site No.** 3 **Structure** Aux. Spillway

Report No. 3 **of** 28 **Mix Number** PC3-200/100 **Inspector** R. Rangel

Specimen Number	1	2	3	10	11	12	1	2	
Specimen Group	11	11	11	12	12	12	3	3	
Number in Group	12	12	12	12	12	12	4	4	
Date Made	5/1/05	5/1/05	5/1/05	5/2/05	5/2/05	5/2/05	5/2/05	5/2/05	
Sample Standard	C1435	C1435	C1435	C1435	C1435	C1435	C42	C42	
L × D (in) (nominal)	12x 6	12x 6	12x 6	12x 6	12x 6	12x 6	10x 6	11x 6	
Weight (lb)	29.35	29.39	29.42	29.39	29.36	28.80	24.46	26.91	
Curing Method	Wet	Wet	Wet	Wet	Wet	Wet	In-place	In-place	
Curing Period (d)	14	14	14	14	14	14	14	14	
Date Tested	5/15/05	5/15/05	5/15/05	5/30/07	5/30/07	5/30/07	5/30/07	5/30/07	
Age Tested (d)	14	14	14	28	28	28	28	28	
Test Standard	C39	C39	C39	C39	C39	C39	C39	C39	
Volume (ft^3)	0.1962	0.1966	0.1965	0.1966	0.1963	0.1967	0.1645	0.1807	
Density (lb/ft^3)	149.6	149.3	149.7	149.5	149.6	146.4	148.7	148.9	
Average Density (lb/ft^3)			149.5			149.5		148.8	
Caps (B = bonded or U = unbonded)	U	U	U	U	U	U	B	B	
L/D	2	2	2	2	2	2	1.67	1.83	
Strength (psi)	1580	1620	1550	2260	2200	1410	1920	1780	
Type of Fracture	1	1	1	2	2	*4	5	5	
Correction Factor							0.97		
Corrected Strength (psi)	1580	1620	1550	2260	2200	~~1410~~	1860	1780	
Average Strength (psi)			1580			2230		2750	

Comments: *Poor compaction indicated by mostly gravel with little paste at approximate depth of 8 inches from top of cylinder.
Cylinders were weighed at the time of molding. Cores were weighed at the time of testing.

U.S. Department of Agriculture
Natural Resources Conservation Service

NEH 645 WS 13.6

RCC Compressive Strength Test Results

Watershed _____ **Site No.** _____ **Structure** _____

Report No. _____ **of** _____ **Mix Number** _____ **Inspector** _____

Specimen Number		2	3	10	11	12	1	2	
Specimen Group									
Number in Group									
Date Made									
Sample Standard									
L × D (in) (nominal)									
Weight (lb)									
Curing Method									
Curing Period (d)									
Date Tested									
Age Tested (d)									
Test Standard									
Volume (ft^3)									
Density (lb/ft^3)									
Average Density (lb/ft^3)									
Caps (B = bonded or U = unbonded)									
L/D									
Strength (psi)									
Type of Fracture									
Correction Factor									
Corrected Strength (psi)									
Average Strength (psi)									

Comments:

This page intentionally left blank.